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NOTES AND LITERATURE

GENERAL BIOLOGY

The Theory of Mimicry.— In an address before the British Association, Dr. F. A. Dixey has reviewed the history of the mimicry hypothesis as an explanation of the resemblances in color pattern between butterflies of diverse genera (*Nature*, 1907, vol. 76, p. 673–678). After visiting the Amazon nearly fifty years ago, Bates suggested that of two species of similar pattern, one was distasteful to birds, and the other had acquired a protective resemblance to it through natural selection. Dr. Dixey states that this was “the first really scientific explanation of the matter” and that it “was at once, and cordially, accepted by Darwin.” He continues,—

“Bates himself was not thoroughly happy about all the facts recorded. He directs attention to the circumstance that not only do the mimics resemble their models but that the models themselves often show an extraordinary resemblance to each other. He speaks of ‘a minute and palpably intentional likeness which is perfectly staggering.’” It was thought that some local or climatic cause, acting equally upon the forms of different groups, might bring about the strange resemblance between them, and “in this supposition Bates was for a time followed by Wallace.”

“It is not to be denied that there is a certain plausibility in this view concerning the direct action of external conditions. It is, for example, a striking fact that the members of a mimetic group of very diverse affinities will, as Bates says, every few hundred miles change their hue and pattern together ‘as if by the touch of an enchanter’s wand.’”

According to Dr. Dixey the key to the puzzle why distasteful forms resemble each other was found by Fritz Müller in 1879. Dr. Dixey states that his suggestion rested on the assumption, since shown mainly by Lloyd Morgan to be correct, that birds have no instinctive knowledge of what forms should be avoided. Hence a certain number of distasteful forms must be sacrificed until their enemies have learned to leave them alone. Now if two distasteful species resemble each other so closely that birds or other enemies do not distinguish between them, the disagreeable experience gained by tasting an individual of

one species will be applied to the benefit of the other, and so each of the two species will need to contribute only a portion of the tax instead of the whole. The greater the number of forms that can be got to share the tax, the better for all, and hence the formation of large 'inedible associations' or Müllerian groups.

In Batesian mimicry the advantage is all on the side of the mimic. In a Müllerian association the benefit is mutual, and Dr. Dixey cites examples showing that two insects may *each* become modified to resemble the other. He concludes that "the fertile suggestion of Fritz Müller went far to supply what was still wanting in Bates's interpretation. Expanded by Meldola and by Poulton, accepted by travelled naturalists like Wallace and Trimen, the Müllerian generalization has proved a powerful means of interpreting many complicated relationships."

Thus the theory of mimicry has been extended to explain not only resemblances between an edible and an inedible form but also between two inedible species. The question arises whether the resemblances have anything to do with edibility. Werner believes that they have not (*Amer. Nat.*, 1907, vol. 41, p. 333). Weismann has found it necessary to gather evidence that any birds eat any species of butterflies to an important extent.¹ He states that in Germany Caspari "let about a hundred butterflies (*Vanessa antiopa*) fly from his window, but not ten of them reached the neighboring wood, all the rest being eaten by swallows which congregated in numbers in front of his window." "Kathariner observed in the highlands of Asia Minor, a flock of bee-eaters which caught in flight and swallowed a great many individuals of a very beautiful diurnal butterfly (*Thais cerisyi*)."² Several other such reports are recorded from various parts of the world, but they do not establish the fact that birds devour butterflies to the extent and with the discrimination which the theory of mimicry demands. The writer's observations in New England lead to the conclusion reached by Judd, that here the native birds seldom molest butterflies. He says,²—In the eastern United States...there are not yet any records of birds habitually preying upon butterflies. In fact the same question has been agitated in the discussion following the reading of Mr. Dixey's most interesting paper at the London Entomological Society; and it was found that comparatively few

¹Weismann, A. *The Evolution Theory*. Translated by J. A. and M. R. Thompson. Vol. 1. London, Edward Arnold, 1904.

²Judd, S. D. *The efficiency of some protective adaptations in securing insects from birds*. *Amer. Nat.*, 1899, vol. 33, p. 461-484.

members had ever seen birds take butterflies. In the eastern United States there have been hardly more than a dozen published records of birds seen in the act of taking butterflies. Birds, so far as I have observed, seem to make no practice of giving chase to the butterflies that float about them as they busily catch other insects. Butterflies seem to be avoided, whether they are indifferently colored, protectively colored or mimetic, or warningly colored. It is said by Wallace that our milkweed butterfly is imitated by *Basilarchia* which thus escapes capture; but, as none of our butterflies are persecuted, it seems strange if mimicry has actually been aimed at. Beddard has shown that there are difficulties in the theory of protective mimicry from the fact that mimicking and mimicked forms are eaten, and that, in certain cases, instances of apparently useless mimicry occur."

In place of the theory of mimicry, a chemical theory of animal coloration may be substituted. Dr. Gadow has described pigments as physiological products of the organism, liable to chemical transformations with corresponding changes in color. Autumn leaves turn from green to yellow and red through such processes, and if a crimson leaf of the red maple resembles one of the Japanese ivy, it is not due to mimicry. What has occurred in *Basilarchia archippus* is a transformation from blue and black to a red like that of *Anosia plexippus*. A comparable change is found in *Semnopsyche diana*; the female is blue and black, but the male is brown and red. It may be noted also that *Speyeria idalia* has red fore wings, and hind wings chiefly blue, but that in the related genus *Argynnis* (in which *Speyeria idalia* was formerly included) both pairs of wings are red. Indeed the resemblance between *Basilarchia archippus* and *Anosia plexippus* is striking, but there is a similar resemblance between the Carolina locust and *Euvanesa antiopa*, and between *Basilarchia astyanax* and *Papilio troilus*. These are not accounted for by mimicry.

If mimicry does not explain the difference in color between the male and female of *Semnopsyche diana*, it may be doubted that the dark female of the yellow *Papilio turnus* in the south is a mimic of *Laertias philenor*. The latter, according to Weismann, is protected by its unpleasant taste and odor, but the odor as described by Comstock, is undoubtedly a perfume to attract and delight its mate. A. H. Pritchett (*Biol. Bull.*, 1903, vol. 5, p. 271-287) found that *Laertias philenor* was eaten by the lizard *Sceloporus floridanus* "with evident relish" in spite of its odor and the fact that its larva fed on the ill-tasting and poisonous *Aristolochia*. The lizard devoured the presumably immune *Anosia plexippus* also.

Piepers ¹ describes the theory of mimicry as superstition and romance which "we still hesitate to abandon, particularly in England,—in *Nature* and the *Trans. of the Entom. Soc. of London* it abounds." From the English journal *Field*, he cites the account of an Egyptian butterfly, in which the hind end so resembles the head end that a bird will be unable to know which way the insect will attempt to escape! Similarly Bashford Dean, at the recent meeting of the American Society of Zoologists in New Haven, ridiculed rather than discussed the theory. He referred to the popularity of the Indian butterfly *Kallima* mounted as mimic of European beech leaves.

The resemblances between butterflies of diverse genera, many of which were known to the older naturalists, remain the interesting feature. Many American books, however, instead of describing them, present the theory of mimicry with the *Anosia-Basilarchia* illustration, and thus "touch only the fringe of a great subject."

F. T. LEWIS.

The Inheritance of Disease.—Professor Bateson, in his last lecture before returning to England, presented a considerable list of human abnormalities which are transmissible, perhaps in Mendelian proportions. Several of these pertain to the eye. Displacement of the lens due to an asymmetrical development of its ligament, is dominant; and also *praesenile cataract*, which occurs at birth or soon after. The largest tabulation of the transmission of abnormality through the descendants of one individual, was a case of inability to see normally except in bright illumination (*hemeralopia*). Color blindness and eye color,—pure blue being recessive — were also discussed. Diagrams were shown illustrating the transmission of hypertrophied skin of palms and soles; of the tendency to blister, known as *epidermolysis bullosa*; of *diabetes insipidus*; and of *haemophilia*, in which there is extensive bleeding from slight wounds. In the last condition males are much more often affected than females, although the apparently unaffected females belonging to the families involved may transmit the disease. This was compared with the inheritance of the horned condition in sheep. A hornless breed crossed with a horned form yields horned males and hornless females, these females transmitting the horns to the males; by further crossing with the horned stock, horned females occur also. Professor Bateson believes that

¹ Piepers, M. C. Noch einmal: Mimicry, Selektion, Darwinismus. Leiden, E. J. Brill, 1907. 481 pp.